DEVELOPMENT OF SPACE INFLATABLE/RIGIDIZABLE STRUCTURES TECHNOLOGY

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Launch cost, which is often directly proportional to launch volume and mass, is a significant portion of the life-cycle cost of a space mission. To align with the increasingly stringent budget environment, NASA has been engaging in the development of breakthrough, high-payoff technologies to enable smaller, lighter and yet more capable spacecraft for future missions. One of these, the space inflatable/rigidizable structures technology, has recently received much attention from the mission planners. Many NASA missions planned for the next decade will rely on space inflatable structures to achieve their launch volume and mass goals. This is especially true for missions employing spacecraft equipped with certain types of hardware components that require relatively large in-orbit configurations to properly perform their assigned functions. Such components include radar antennas, solar arrays, sunshields, telescope reflectors, and aerobrakes. Presently, deployable structures are used to construct these components to overcome the limitations of fairing size at launch. Compared to deployable structures, space inflatable/rigidizable structures have the advantages of much lighter weight, higher packing efficiency and, most importantly, higher deployment reliability. It is believed that inflatable/rigidizable structures will replace deployable structures for many space applications in the foreseeable future.

This paper gives an overview on the development of space inflatable/rigidizable structures. Design concepts of two recent example applications will be described in some details. The first, a typical planar frame structure requiring one-dimensional deployment, is the inflatable synthetic aperture radar (SAR) array antenna (Fig. 1) developed for the Advanced Radar Technology Program (ARTP). The second, also a planar structure but requires two-dimensional packing and deployment, is the inflatable sunshield (Fig. 2) for the Next Generation Space Telescope (NGST). Both of these example applications use inflatable/rigidizable structures to carry multiple layers of stretched membranes that are designed to perform specific functions such as RF or thermal insulation. Based on the concept development, engineering model design and fabrication and ground test experience, several major challenges for future technology development of space inflatable/rigidizable structures, including high-efficiency packing, controlled deployment, in-orbit rigidization, space survivability of materials, lightweight and compact inflation systems, and launch restrain/release mechanisms, are identified and discussed.

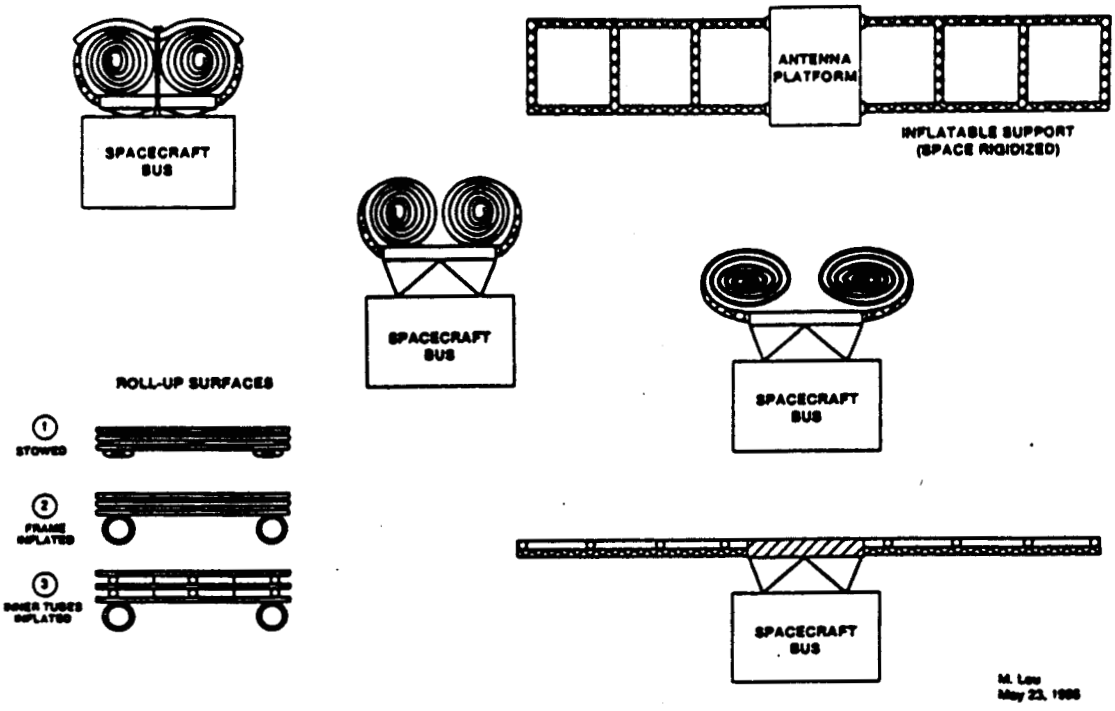
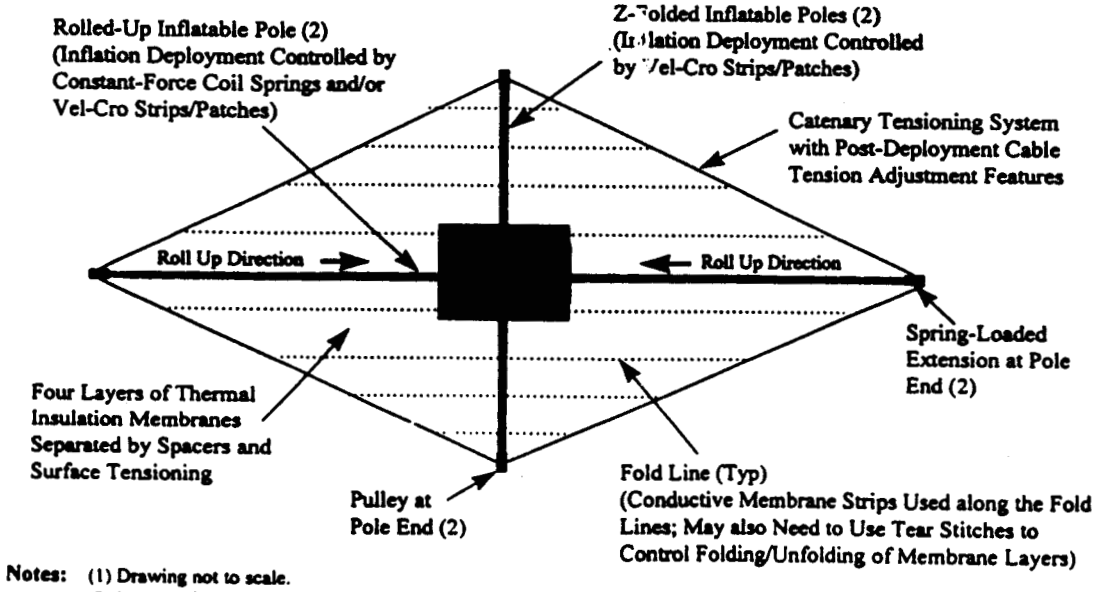


Figure 1 Conceptual Design of ARTP Roll-Up Inflatable SAR



Notes: (1) Drawing not to scale.
(2) Length of the long poles is up to 16 meters.
(3) Stretched-aluminum (reinforced) is the preferred candidate space rigidization method for the inflatable poles at this time.
(4) Packing is by folding followed by rolling.
(5) Launch restraints and release mechanisms TBD.

M. Lou; 9/14/97
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Figure 2 Conceptual Design of NGST Inflatable Sunshield